Logic Diagram Workshop

Introduction

Instructor:

- David Sellers
- Senior Engineer
- Facility Dynamics Engineering

Class Material Location

- The slides and other supporting information for the class can be found at:

http://www.av8rdas.com/pacific-energy-center-classes1.html#Current

- They will be there until the next class, at which time they will be relocated down the page.
- About using my spreadsheets and other resources:
  - They are my tools vs. tools I developed to be used by others
  - Use at your own risk; I provide them as a resource for you to use as a starting point
  - You still need to understand how it works and fix it if it doesn't work for you

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Learning Objectives

After completing this course you should be able to:

1. Recognize the value of clearly communicating control logic and how logic diagrams can facilitate this
2. Understand the steps associated with organizing your control logic development
3. Understand ways to present control logic
4. Understand ways to verify control logic
5. Appreciate that that control logic needs to address not only the requirements of the design day but also the requirements of all of the other days of the year
6. Understand that control logic needs to reflect the physics of the system it is applied to

Agenda

- Introduction and Overview
- Basic Logic Concepts
- Basic Logic Blocks
- Applying Basic Logic Blocks to Control a Light
- Advanced Logic Blocks
- Appling Advanced Logic Blocks
- Commissioning Logic
- Wrap-up

The Fundamental Goal of the Control System

Automatically adjust a piece of machinery to give us what we want by comparing what is going on to what we want to go on and making appropriate adjustments to the process we want to control

The Holistic (Green) Goal of the Control System

Automatically adjust a piece of machinery to give us what we want by comparing what is going on to what we want to go on and making appropriate adjustments to the process we want to control as efficiently and sustainably as possible

The “Three R’s”

- Repeatable
  - To make, do, or perform (an action) again (and again, and again, and again ….)
- Reliable
  - Giving the same result on successive trials
- Robust
  - Sturdy; capable of performing without failure under a wide range of conditions

Control System Building Blocks

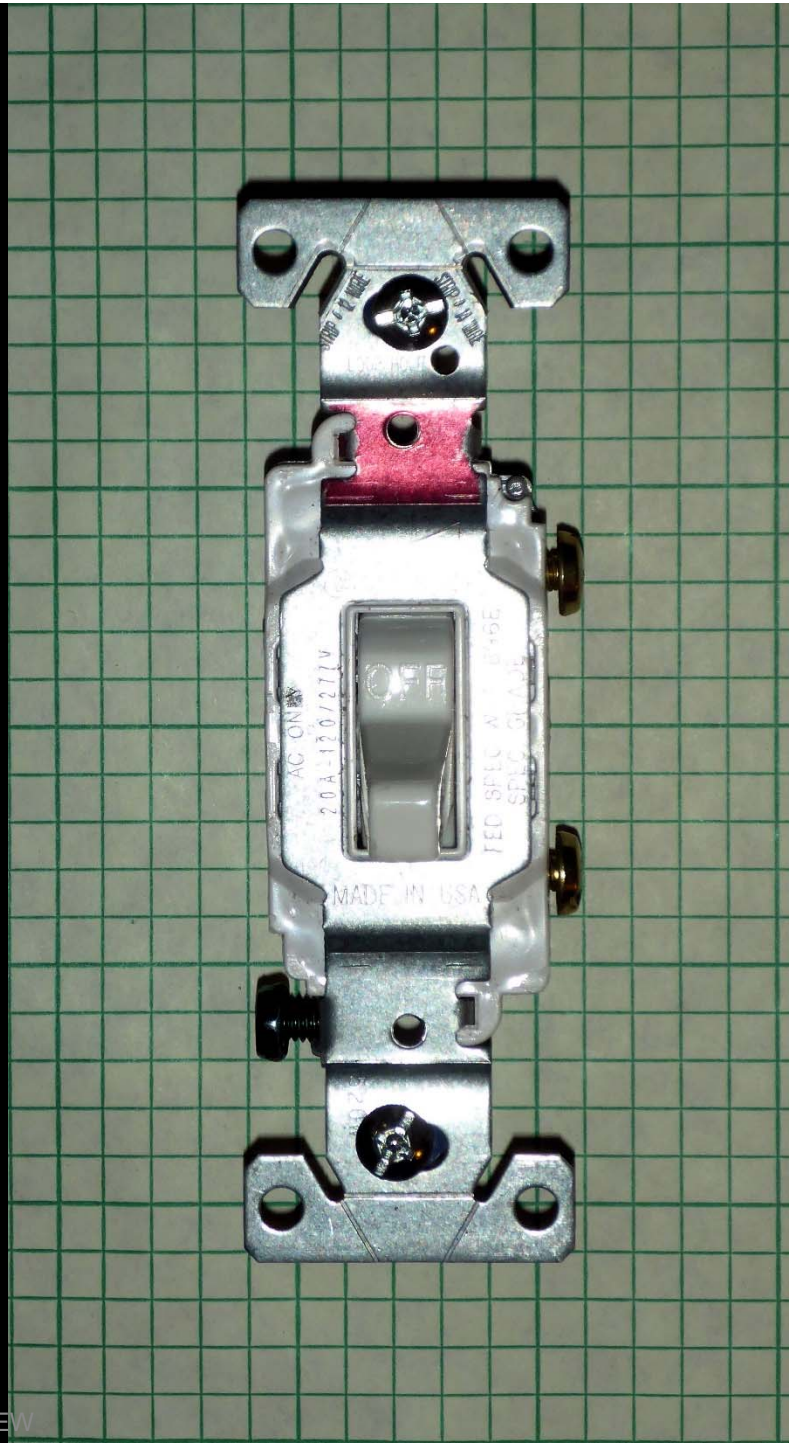
Automatically adjust a piece of machinery to give us what we want by comparing what is going on to what we want to go on and making appropriate adjustments to the process we want to control

Control System Building Blocks

Automatically adjust a piece of machinery to give us what we want by comparing what is going on to what we want to go on and making appropriate adjustments to the process we want to control

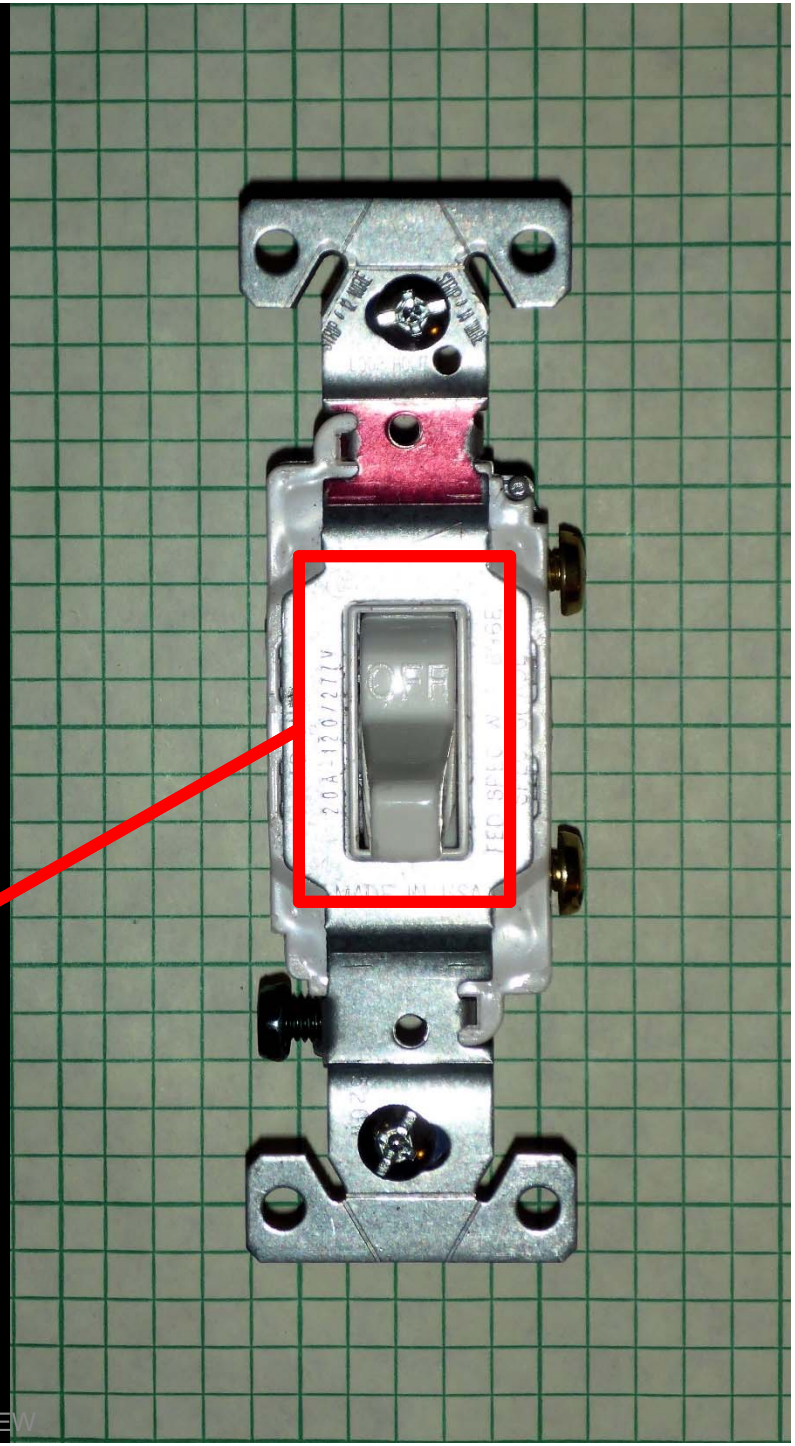
- Inputs
- Measure the process variable

A Digital Input



A Digital Input

With automatic operating state indication …



A Digital Input

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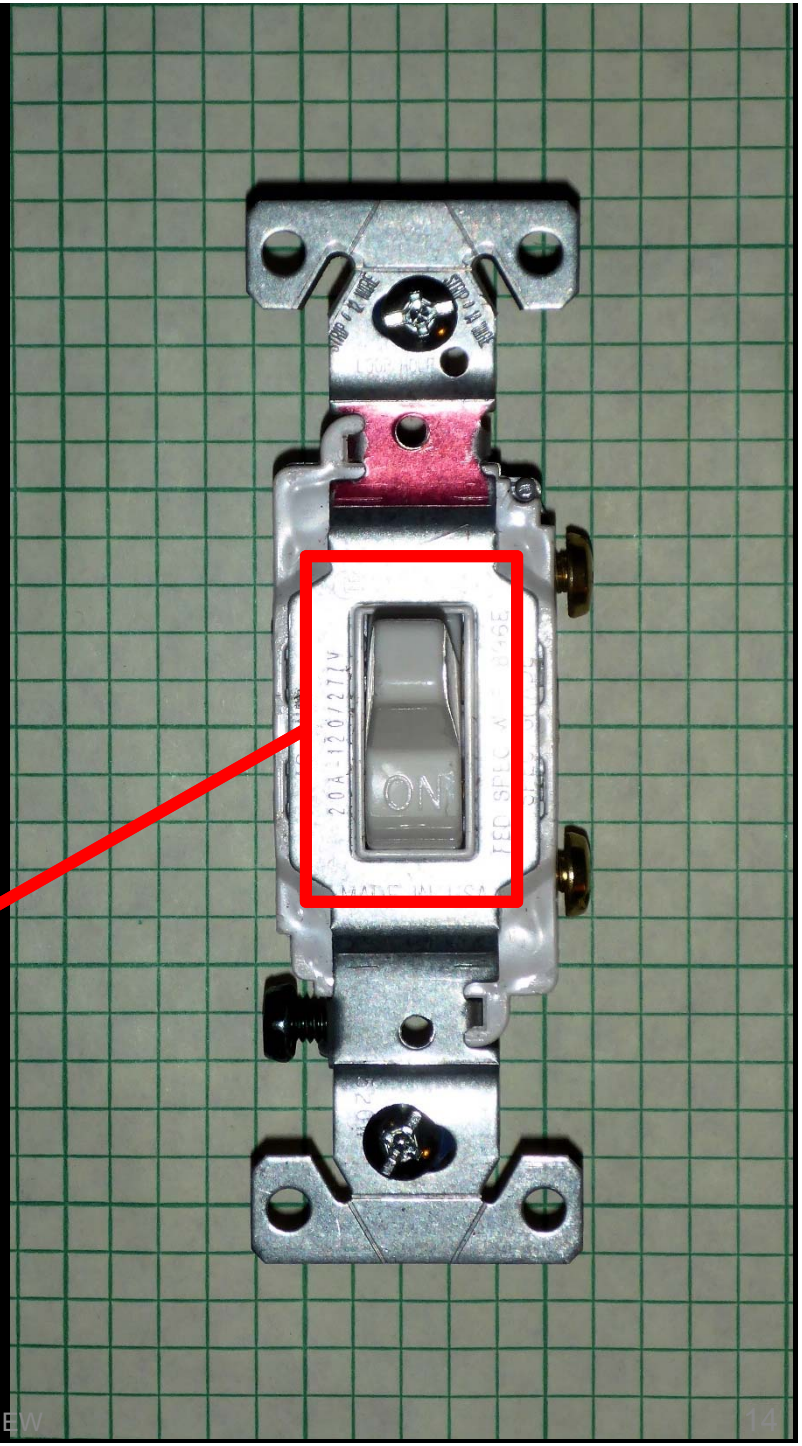
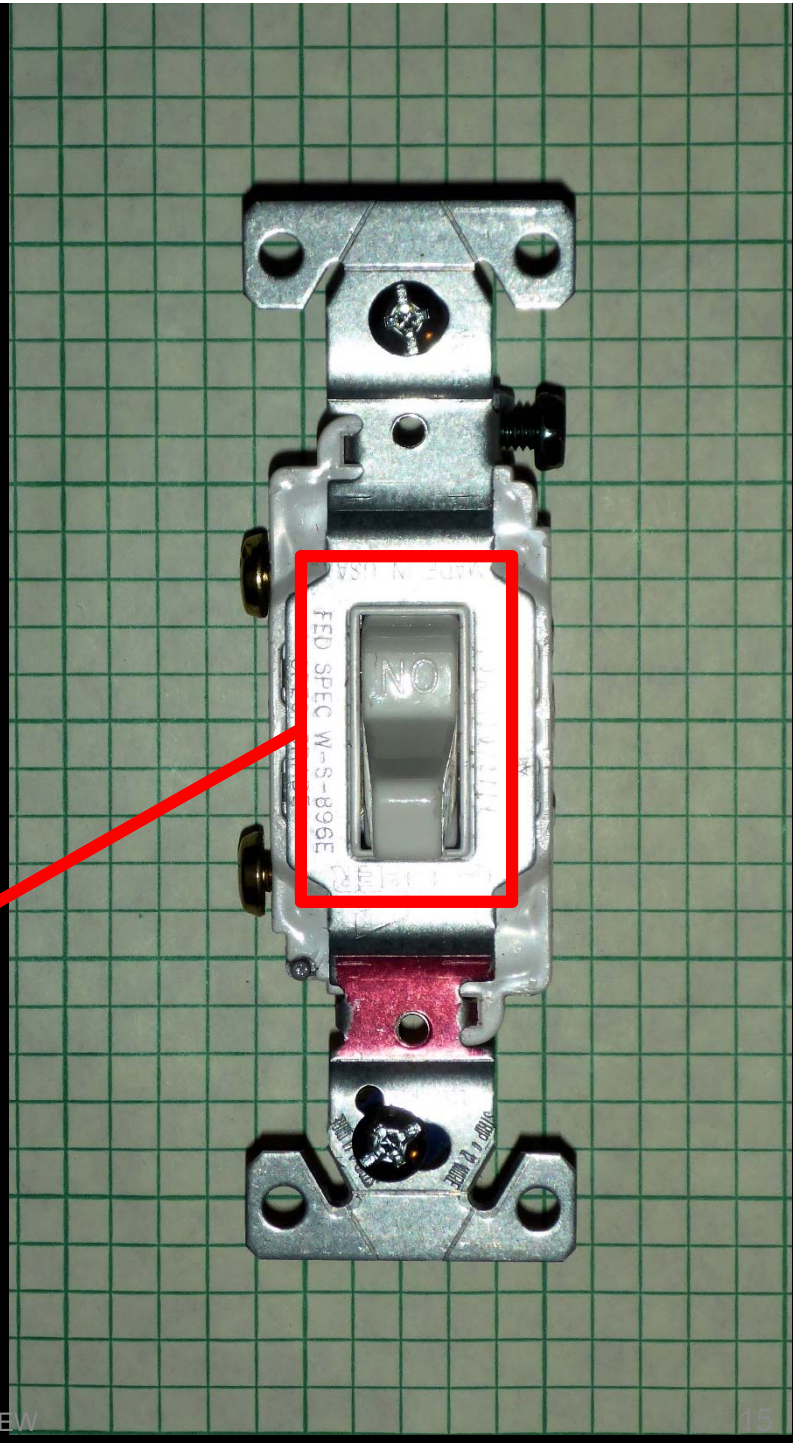


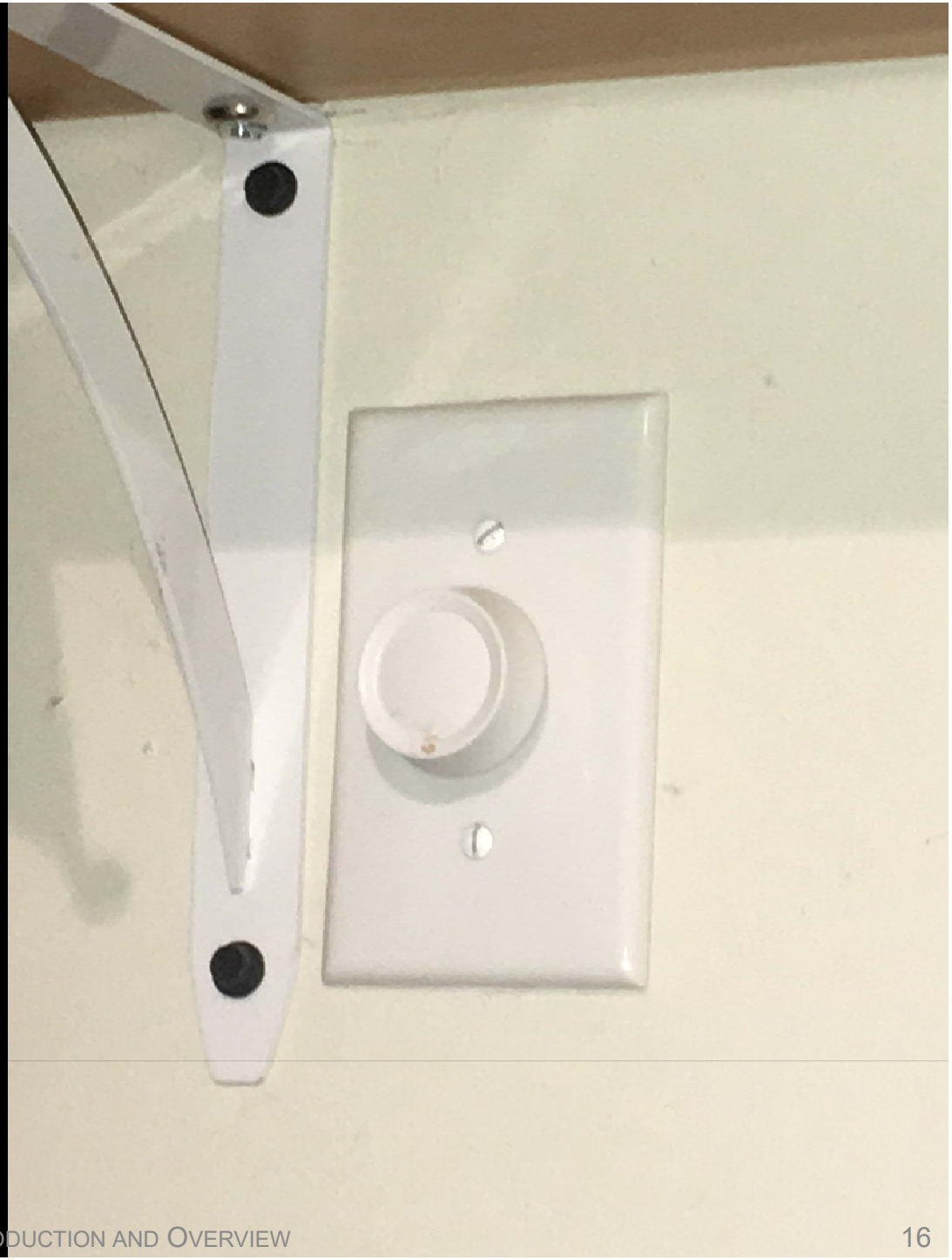
A Digital Input

… and automated fault detection

Tom McCarthy



An Analog Input



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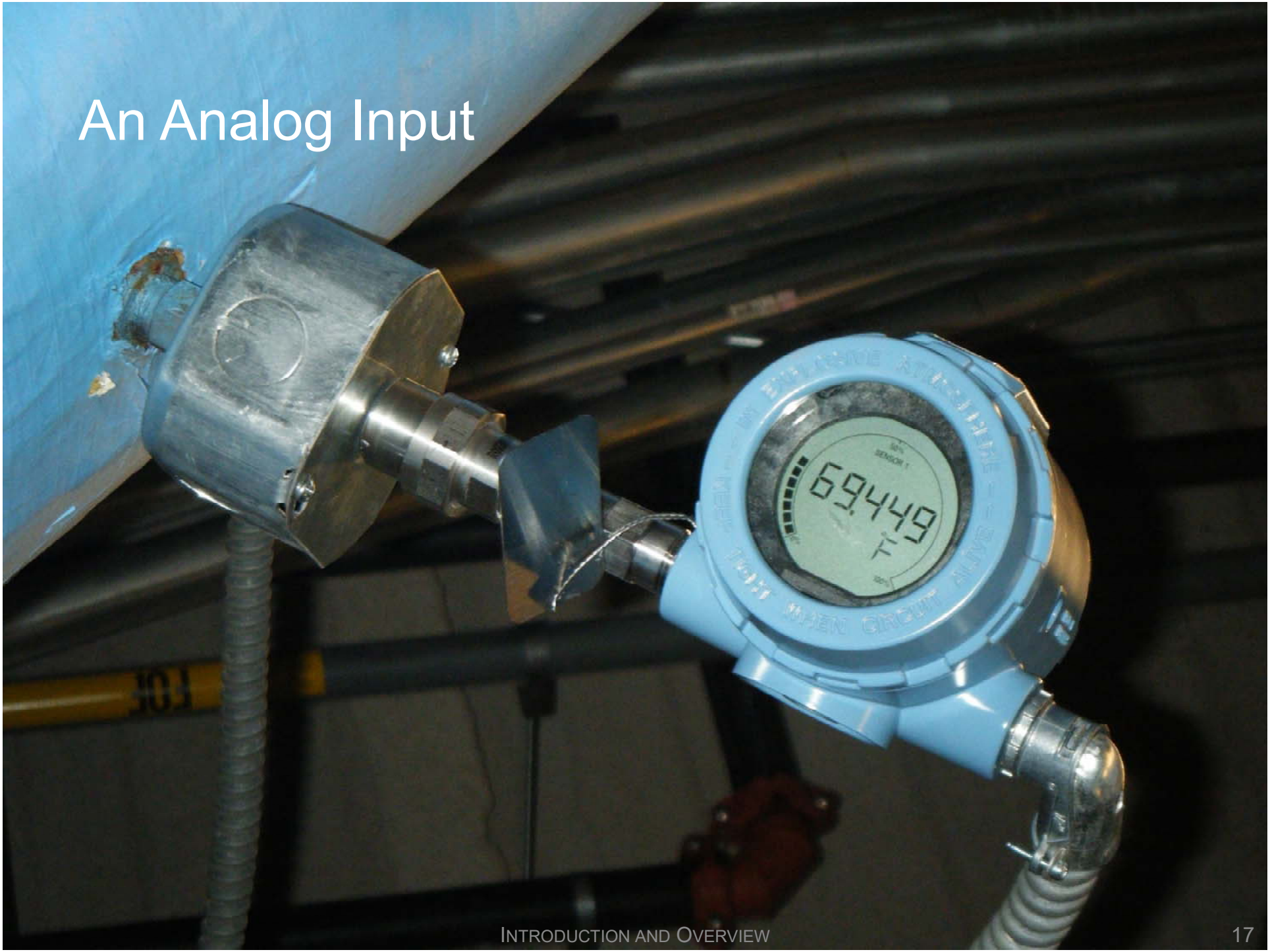
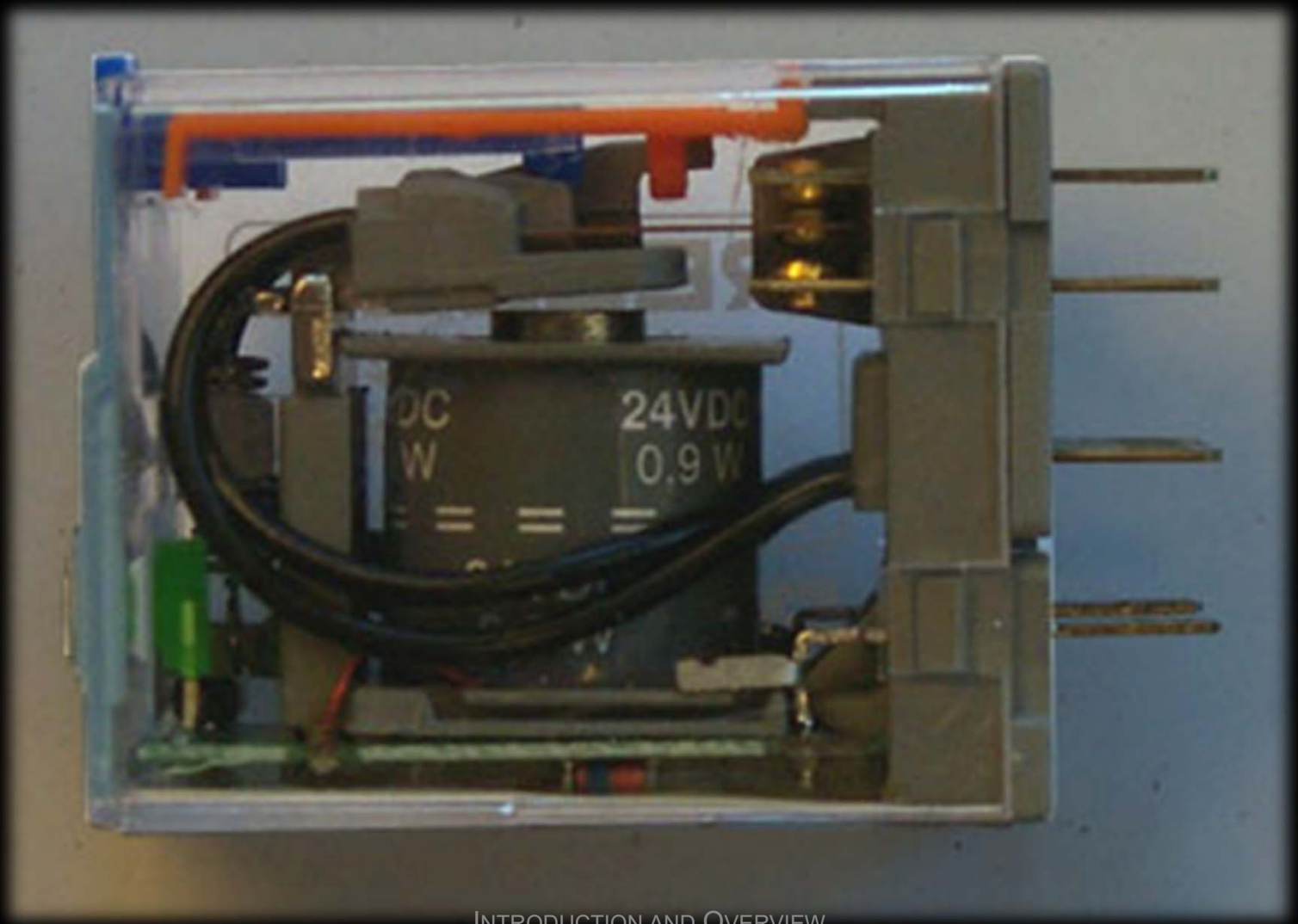


Control System Building Blocks

Automatically adjust a piece of machinery to give us what we want by comparing what is going on to what we want to go on and making appropriate adjustments to the process we want to control

- Inputs
- Outputs
- Measure the process variable
- Adjust the controlled variable

An Digital Output



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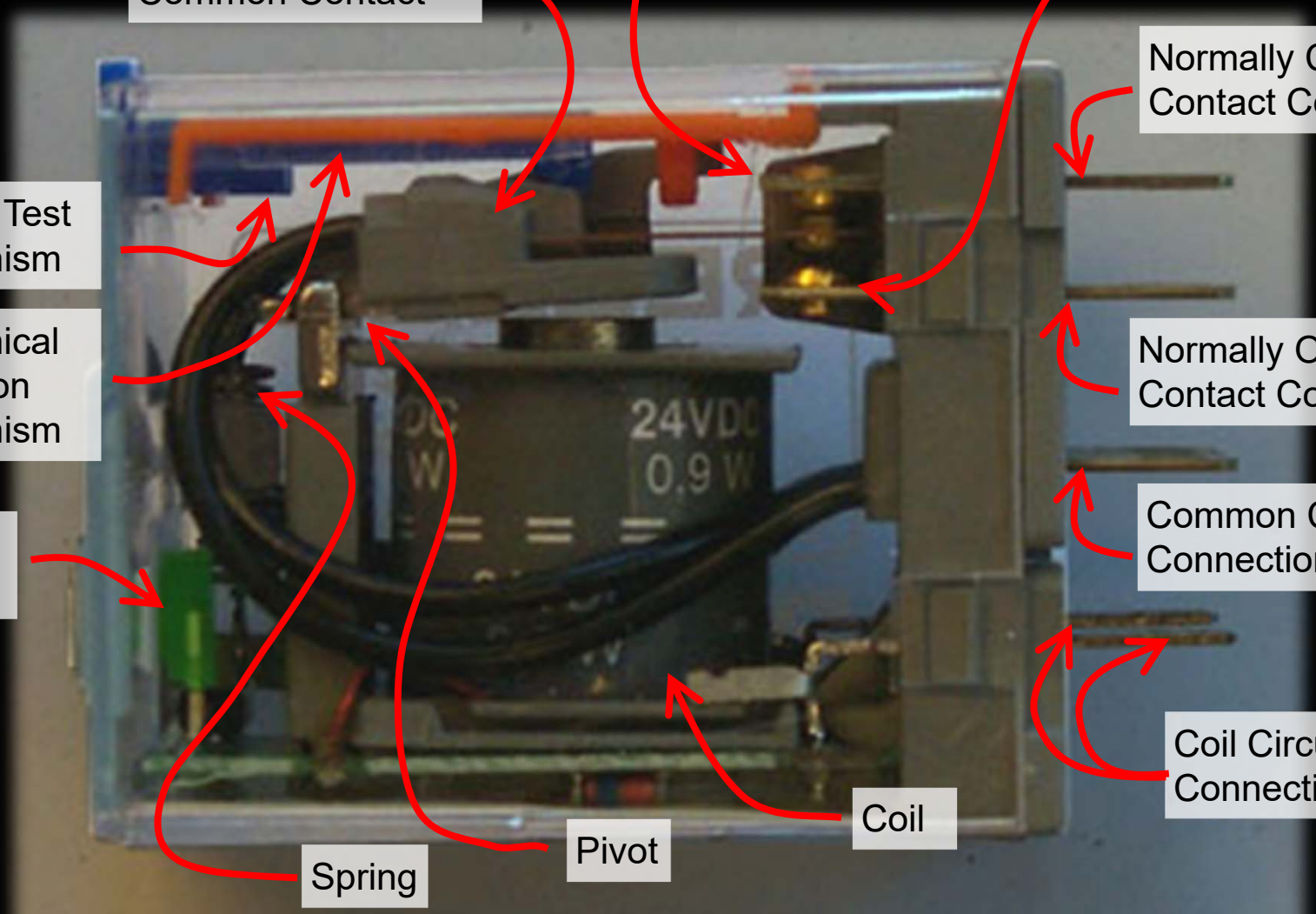


Armature and Common Contact

Normally Closed Contact

Normally Open Contact

Normally Closed Contact Connection

Manual Test Mechanism

Mechanical Indication Mechanism

Normally Open Contact Connection

LED Indicator

Common Contact Connection

Coil Circuit Connections

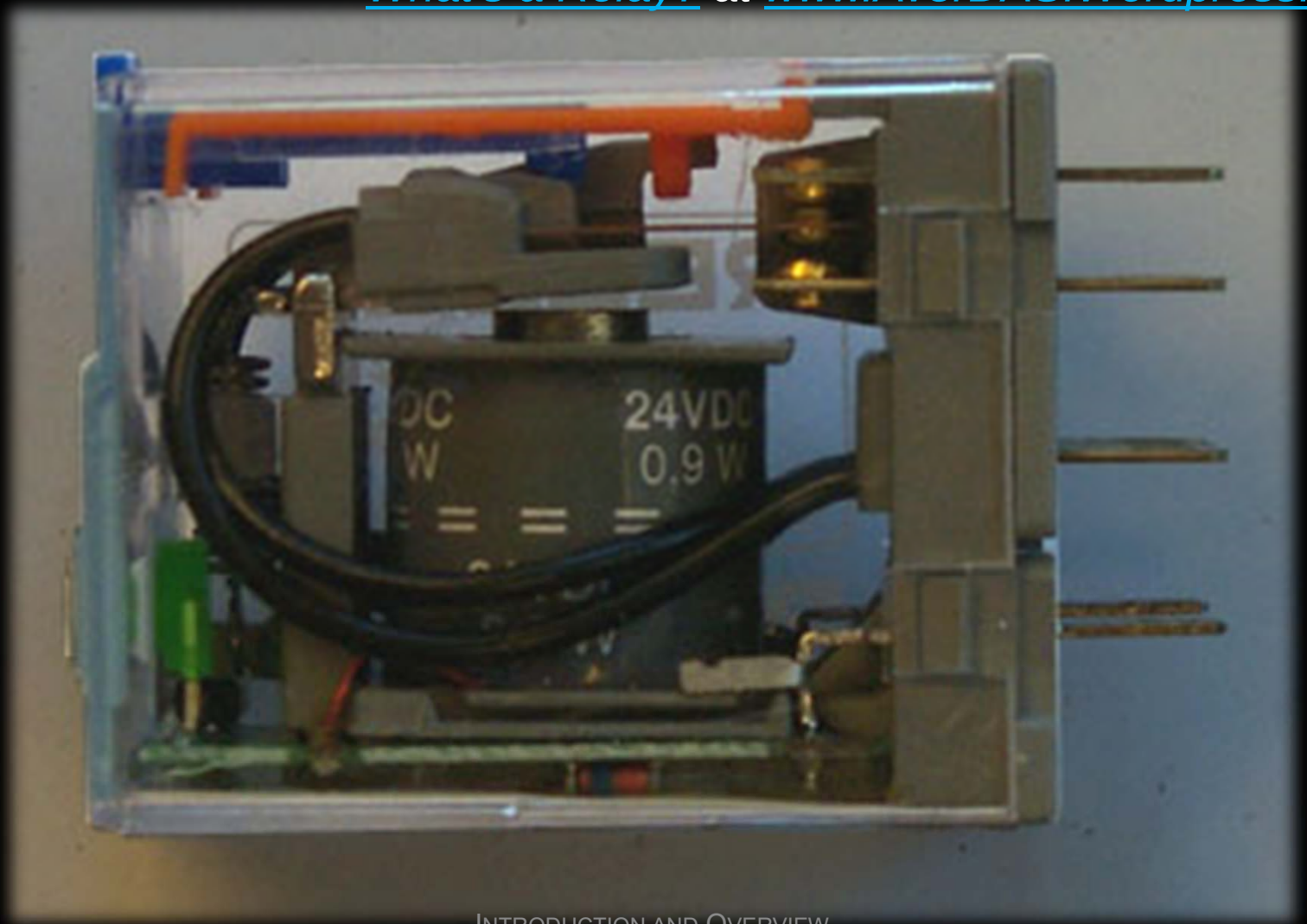
Coil

Pivot

Spring

An Digital Output

For More on Relays, see [Learning about Relay Logic; What's a Relay?](#) at [www.Av8rDAS.Wordpress.com](#)



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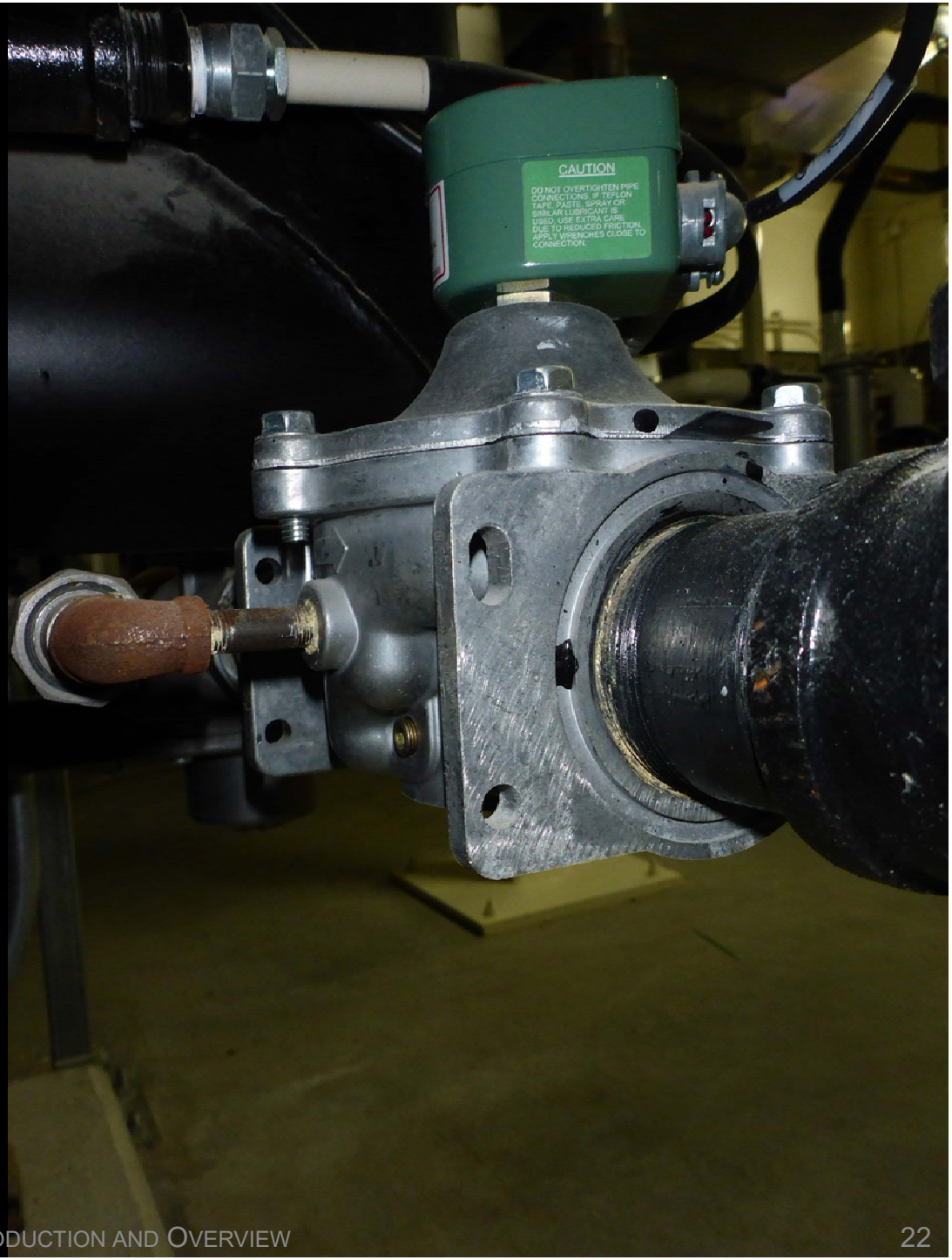

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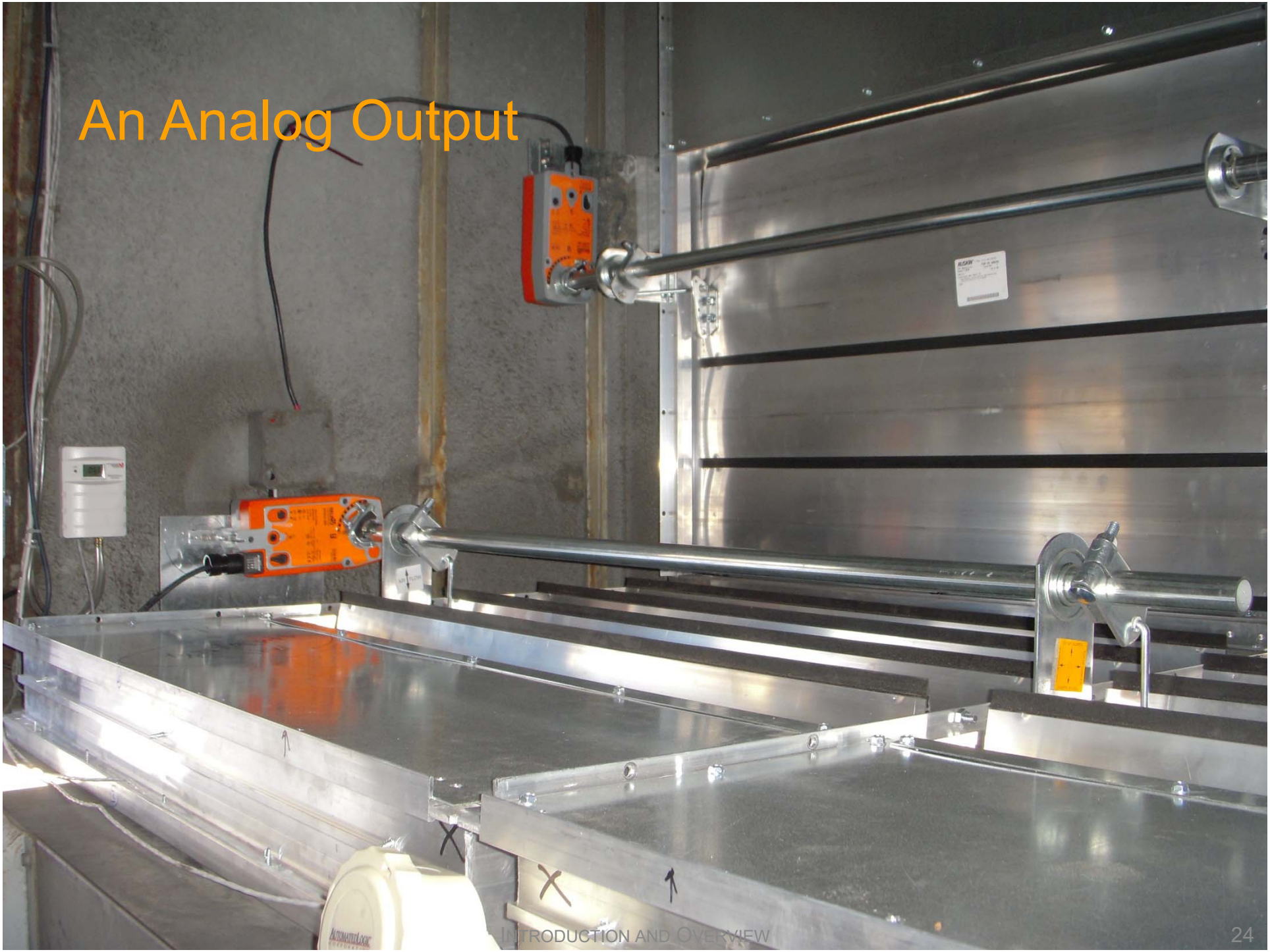


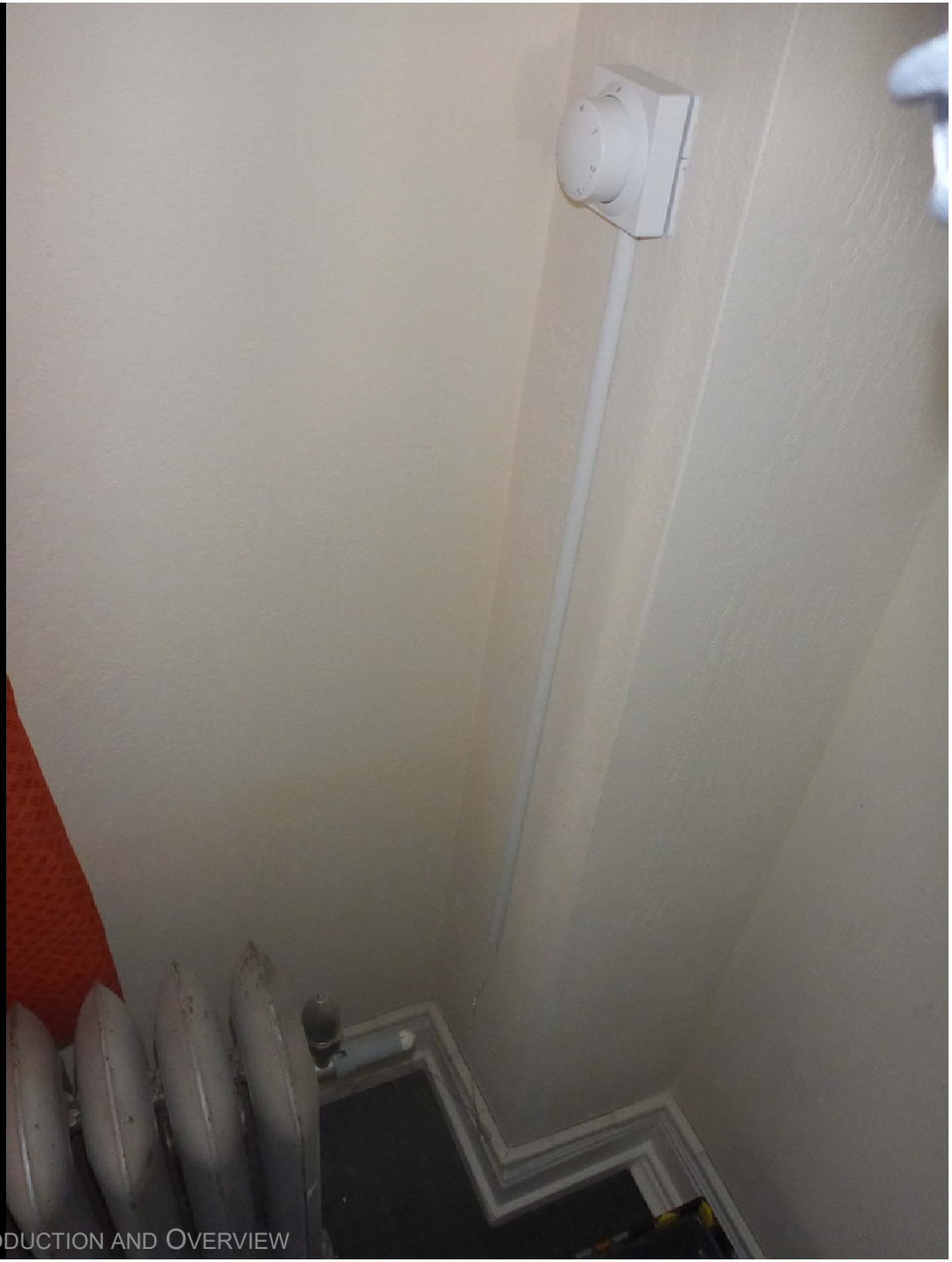
Control System Building Blocks

Automatically adjust a piece of machinery to give us what we want by comparing what is going on to what we want to go on and making appropriate adjustments to the process we want to control

- Inputs
- Outputs
- Set Point

- Measure the process variable
- Adjust the controlled variable
- Our requirements for the process that is under control, which can be fixed or variable

An Set Point Adjustment



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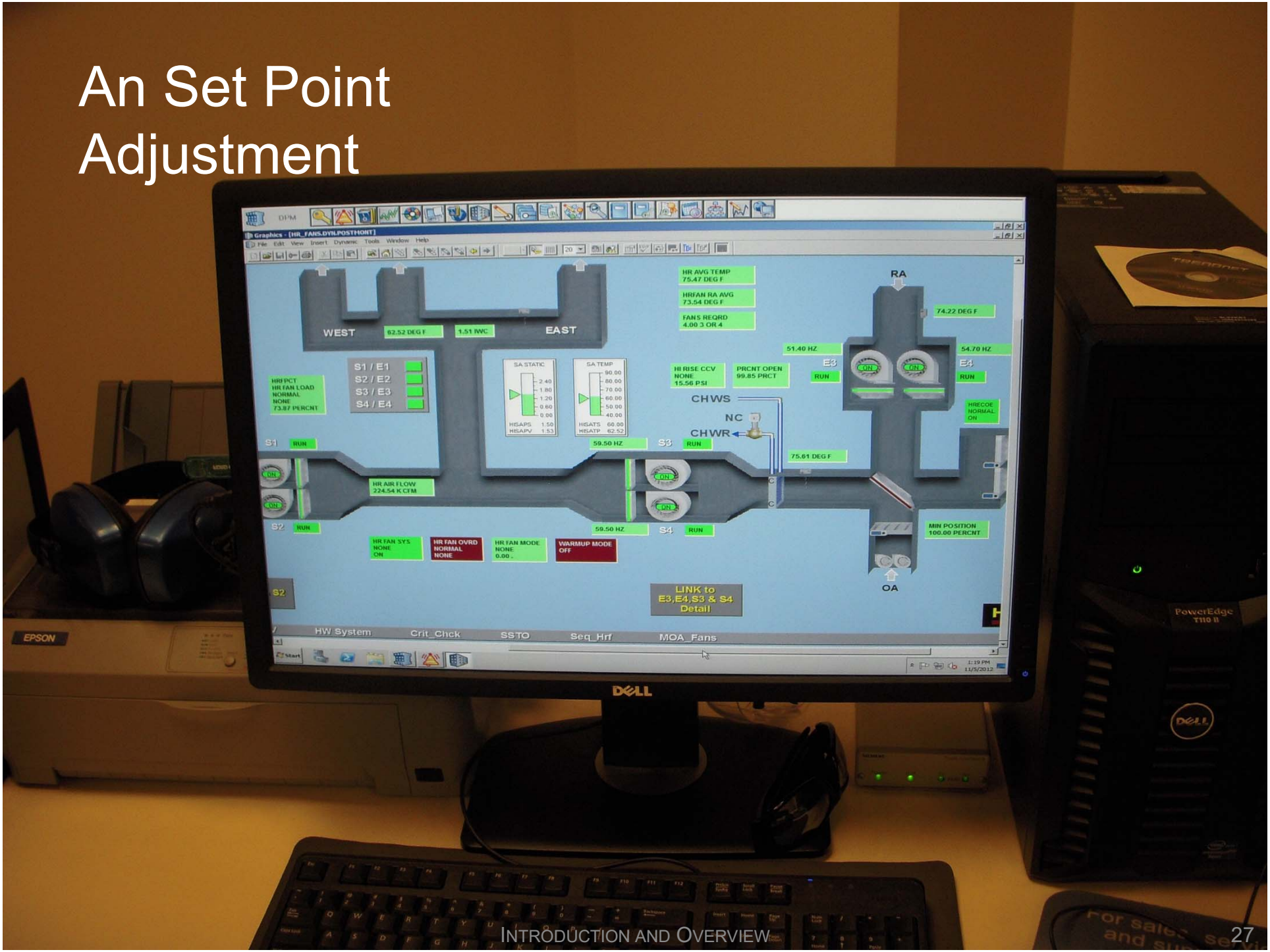

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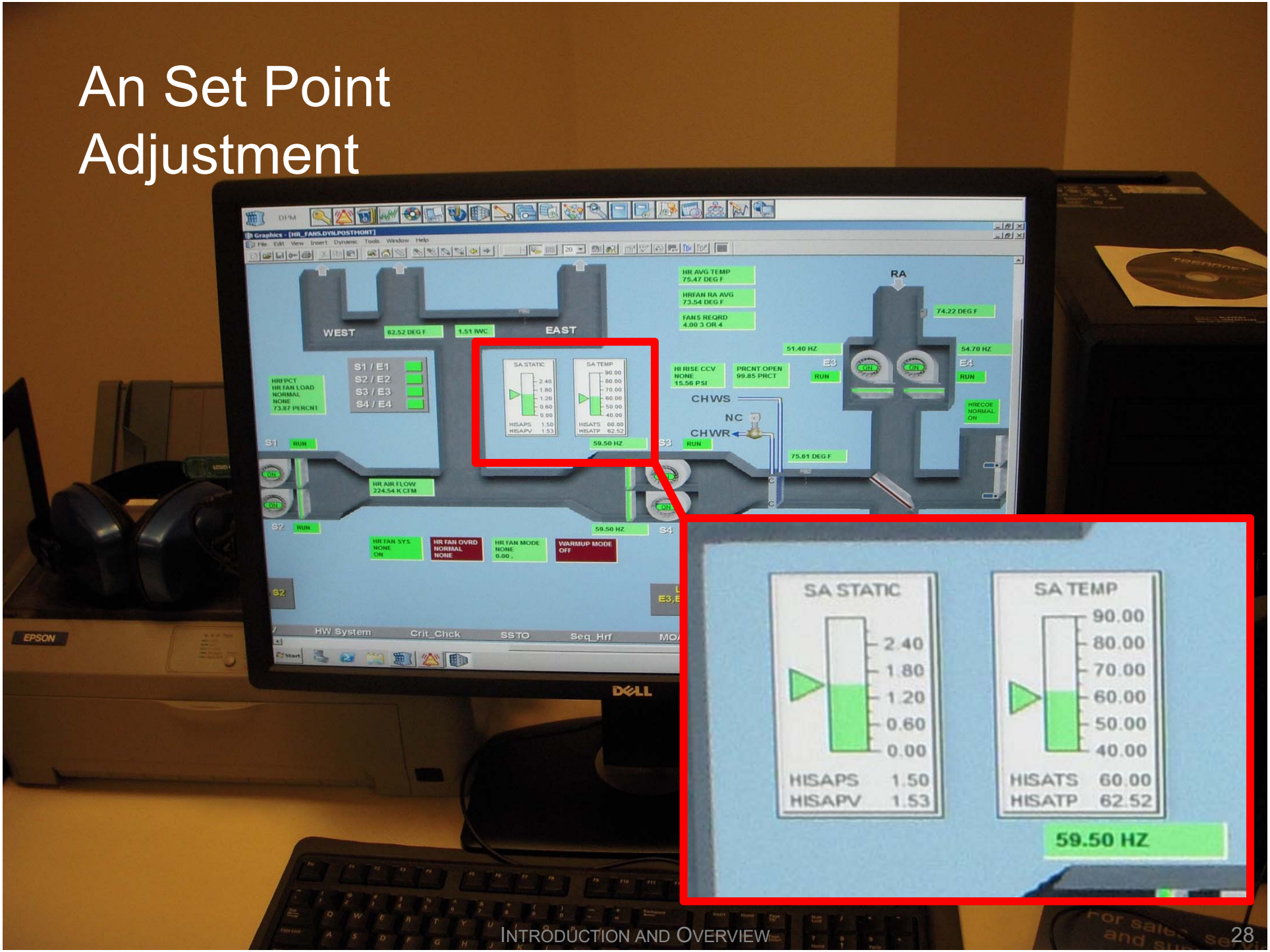


Control System Building Blocks

Automatically adjust a piece of machinery to give us what we want by comparing what is going on to what we want to go on and making appropriate adjustments to the process we want to control

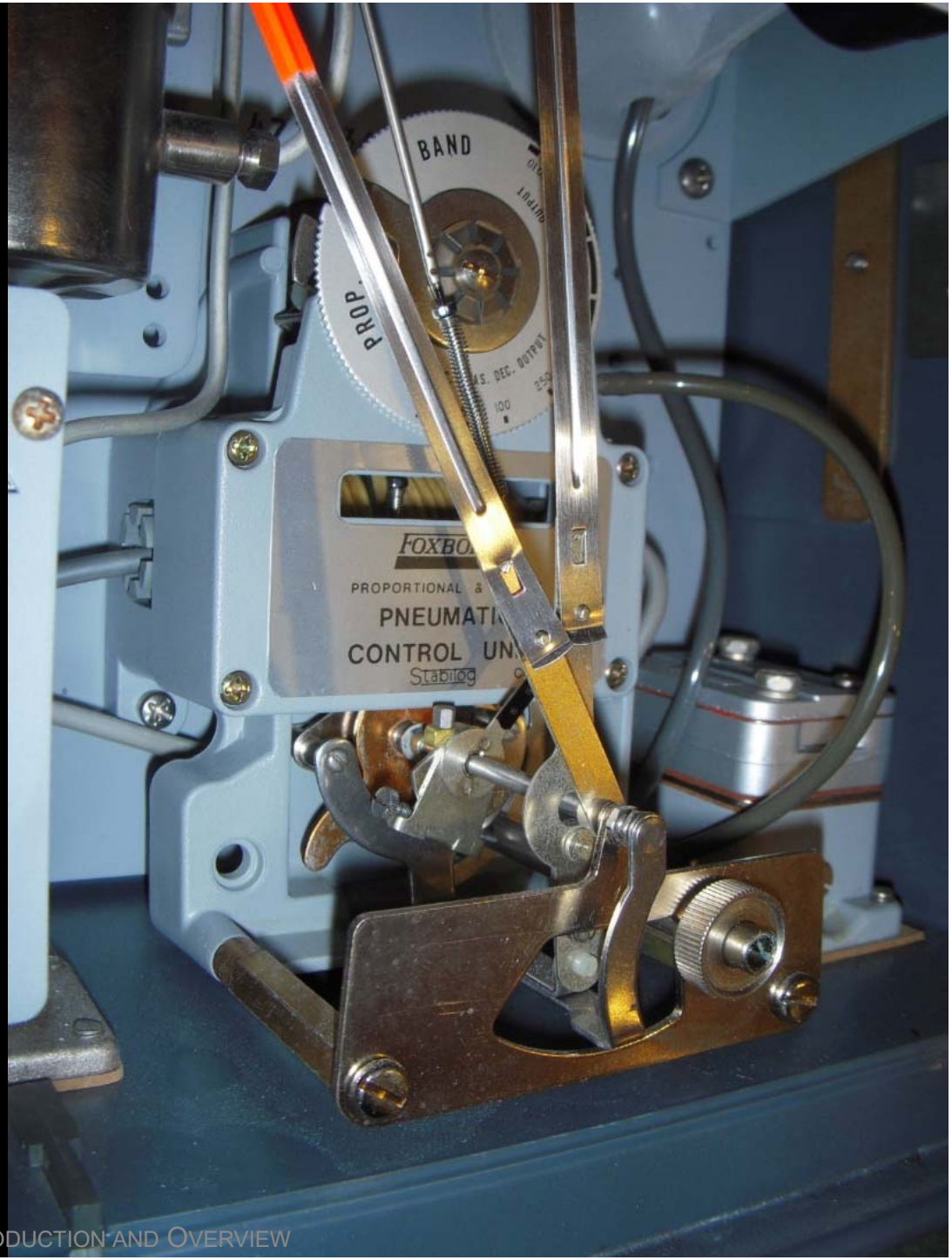
- Inputs
- Outputs
- Set Point
- Control Process

- Measure the process variable
- Adjust the controlled variable
- Our requirements for the process that is under control, which can be fixed or variable
- Logic and algorithms that try to bring the controlled variable into agreement with the set point

Digital Logic

Digital Logic

Analog Logic



A Long, Long, Time Ago, in a Galaxy Far, Far, Away, Logic Was a Physical Thing

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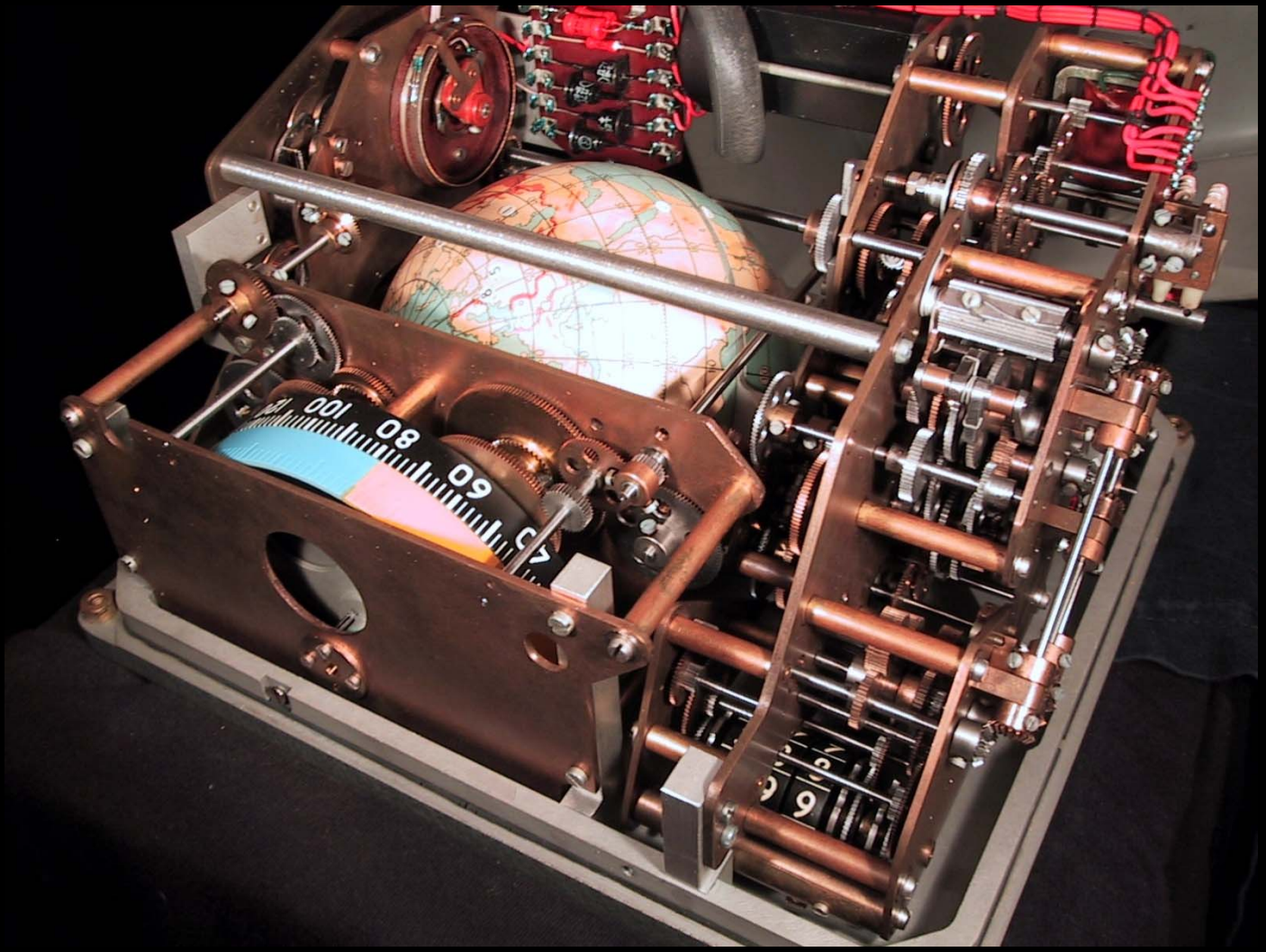

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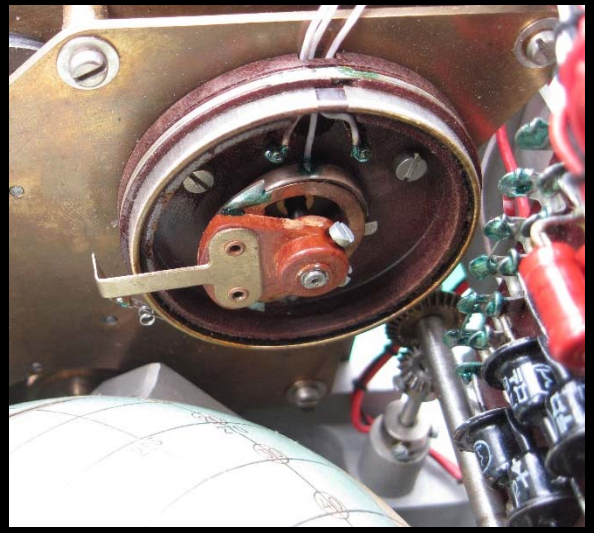

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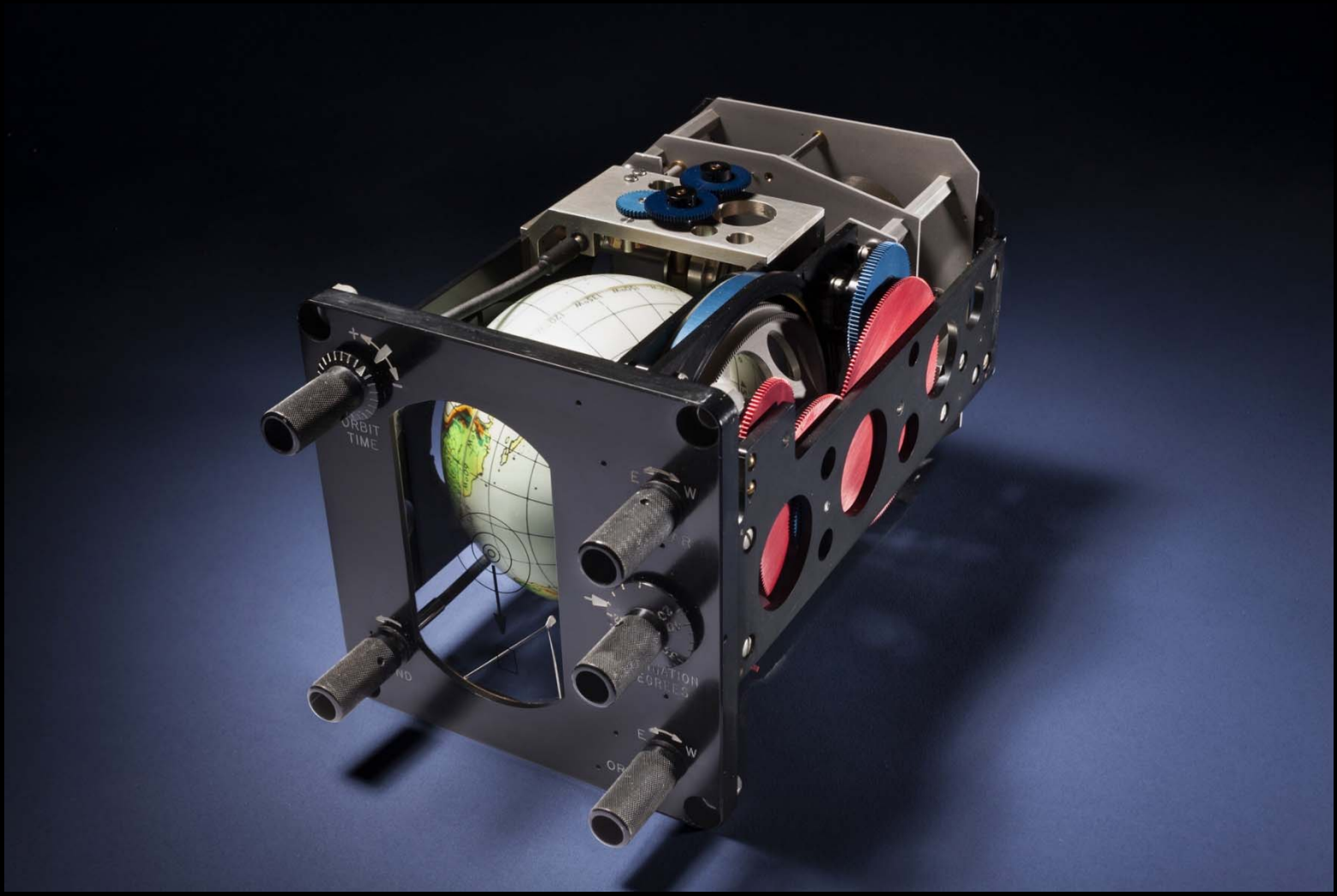

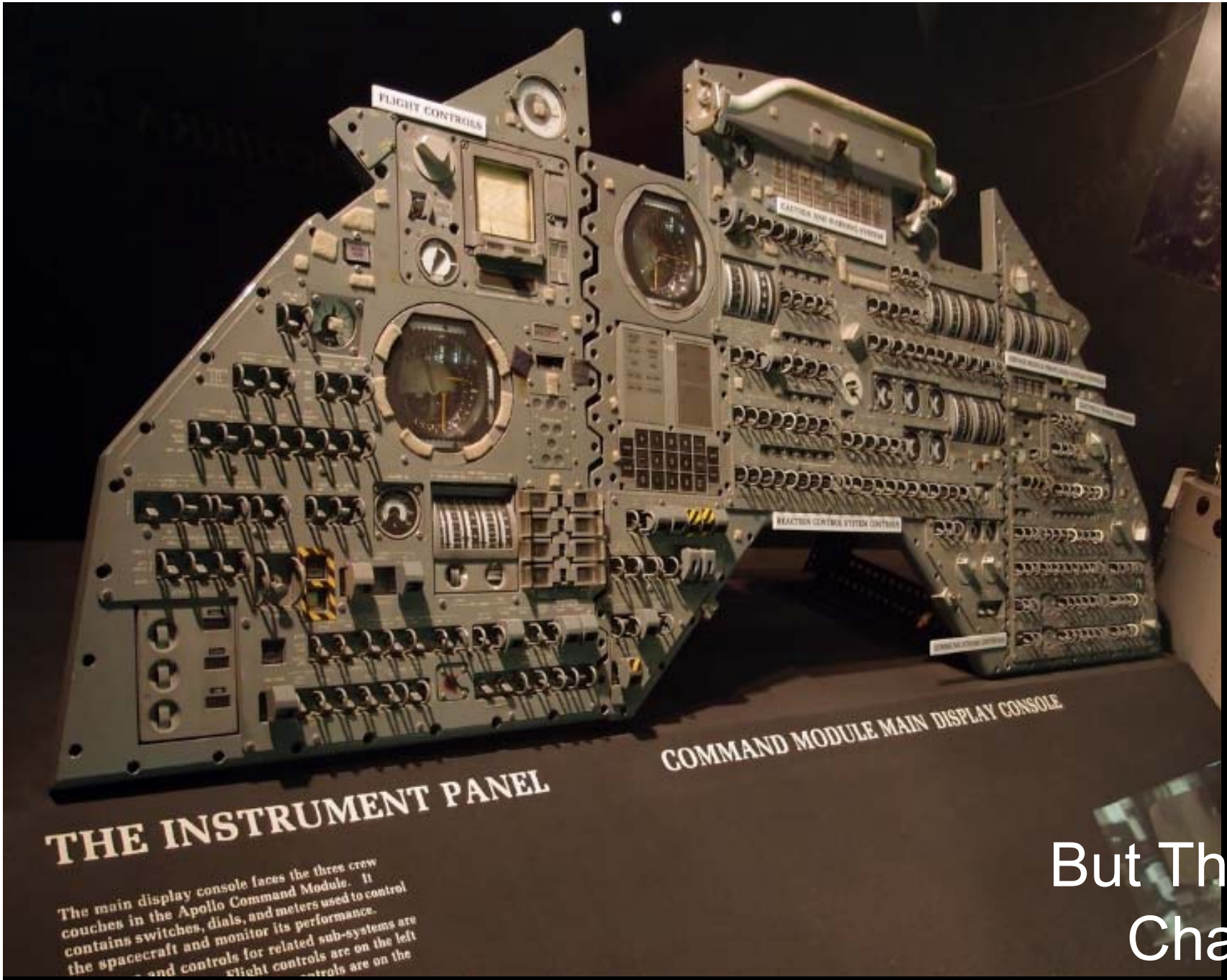

But Things Change

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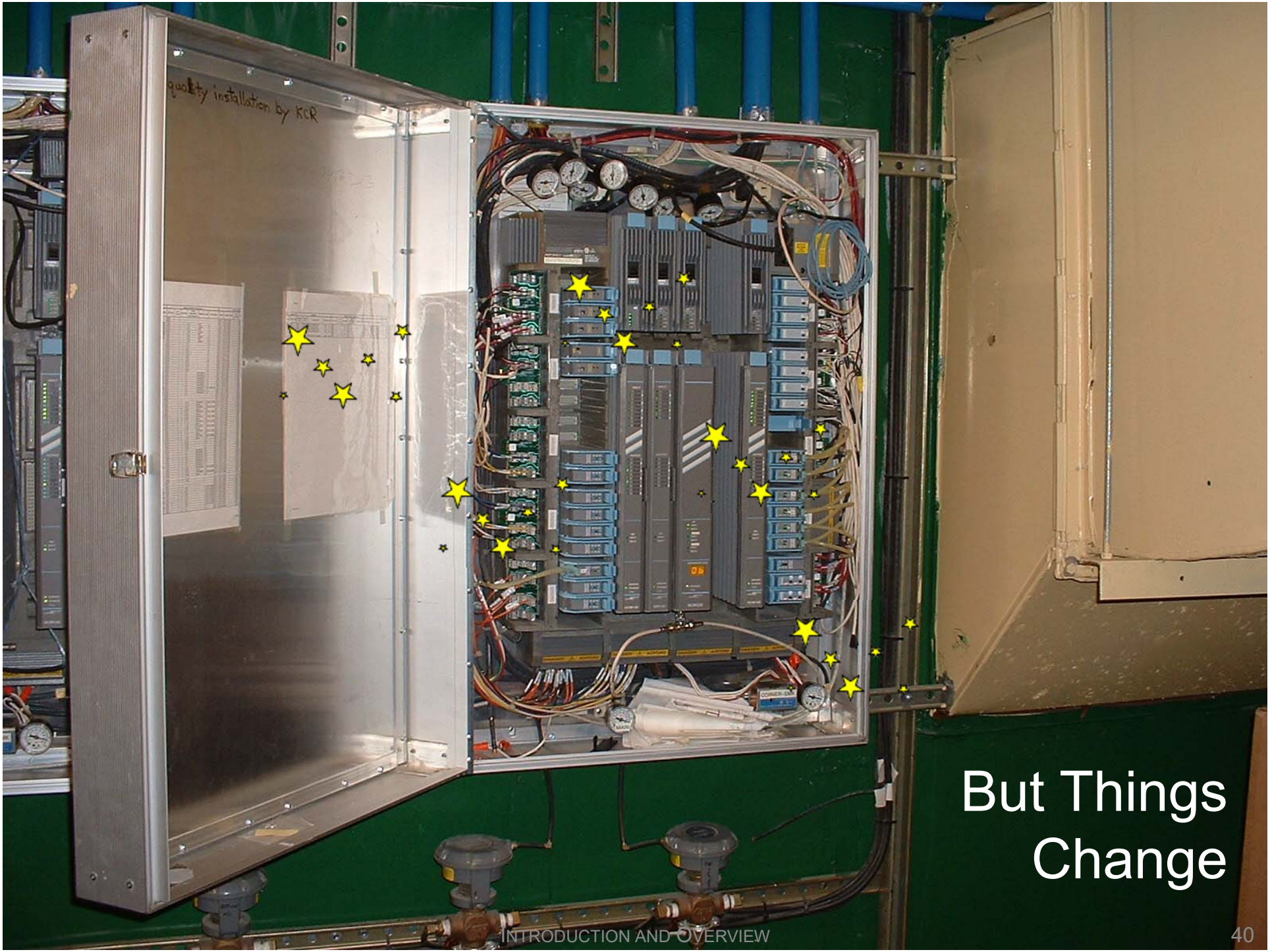
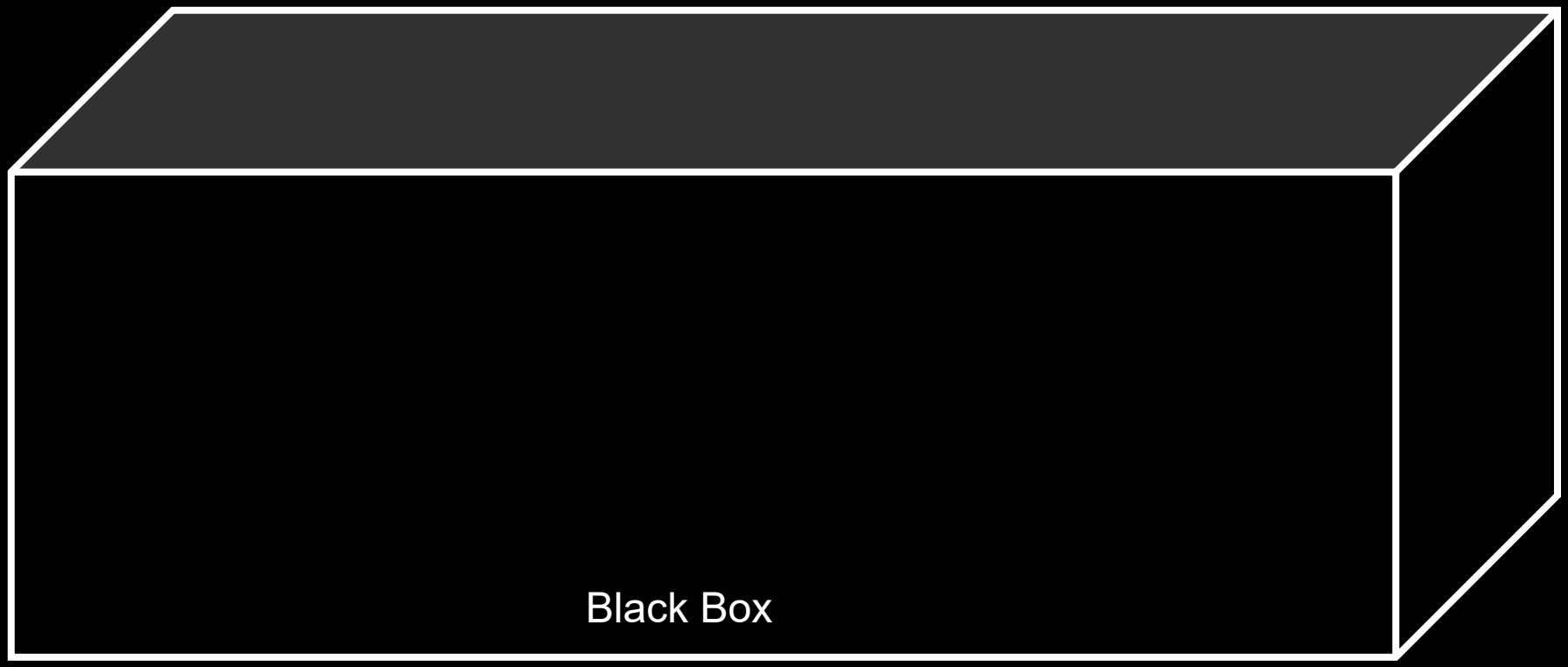


But Things Change

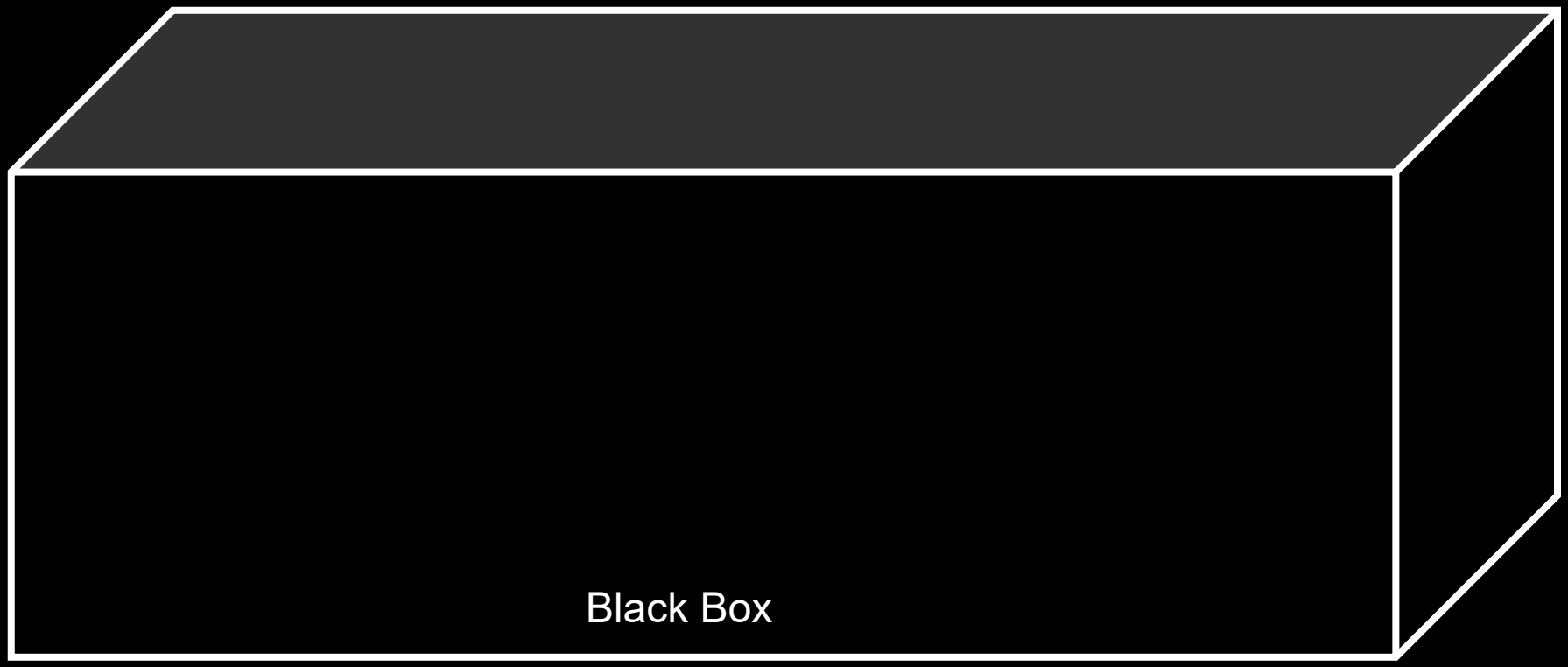
Not Being Able to See or Get Your Hands on What's Going On

… a down side to DDC



Even Though You Can't See Them …

… the inner workings and controlling software of a DDC controller are critical to success



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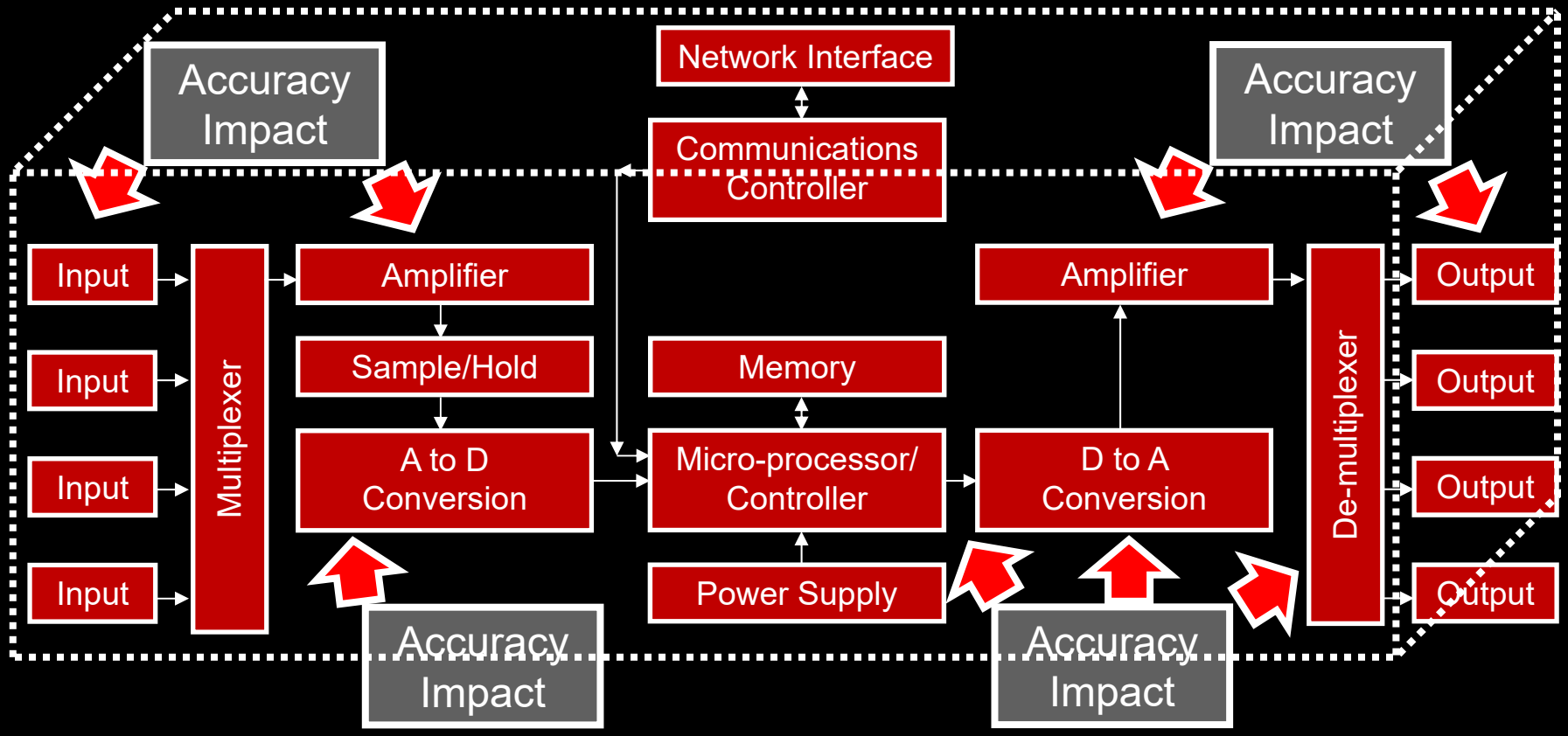

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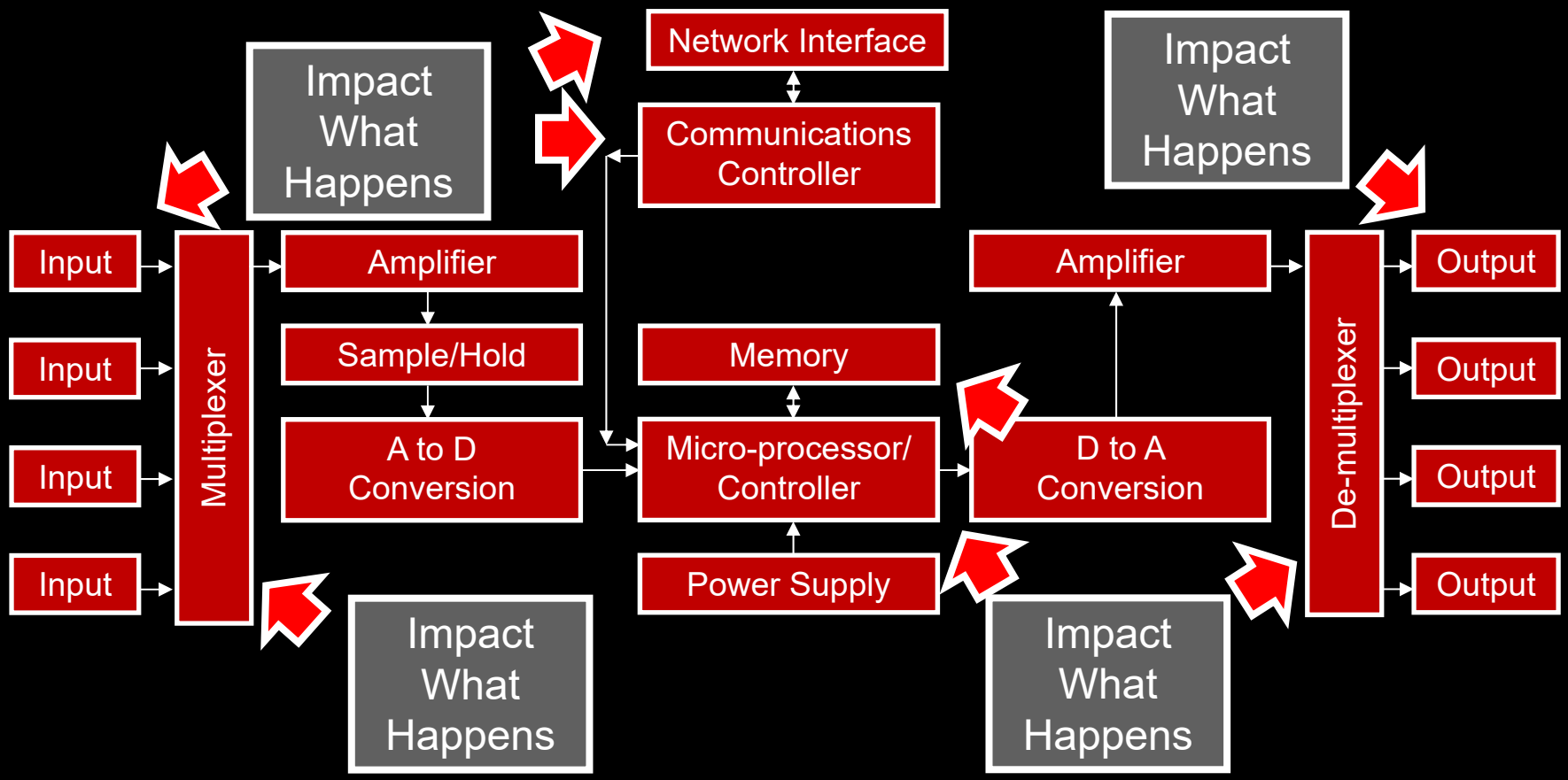

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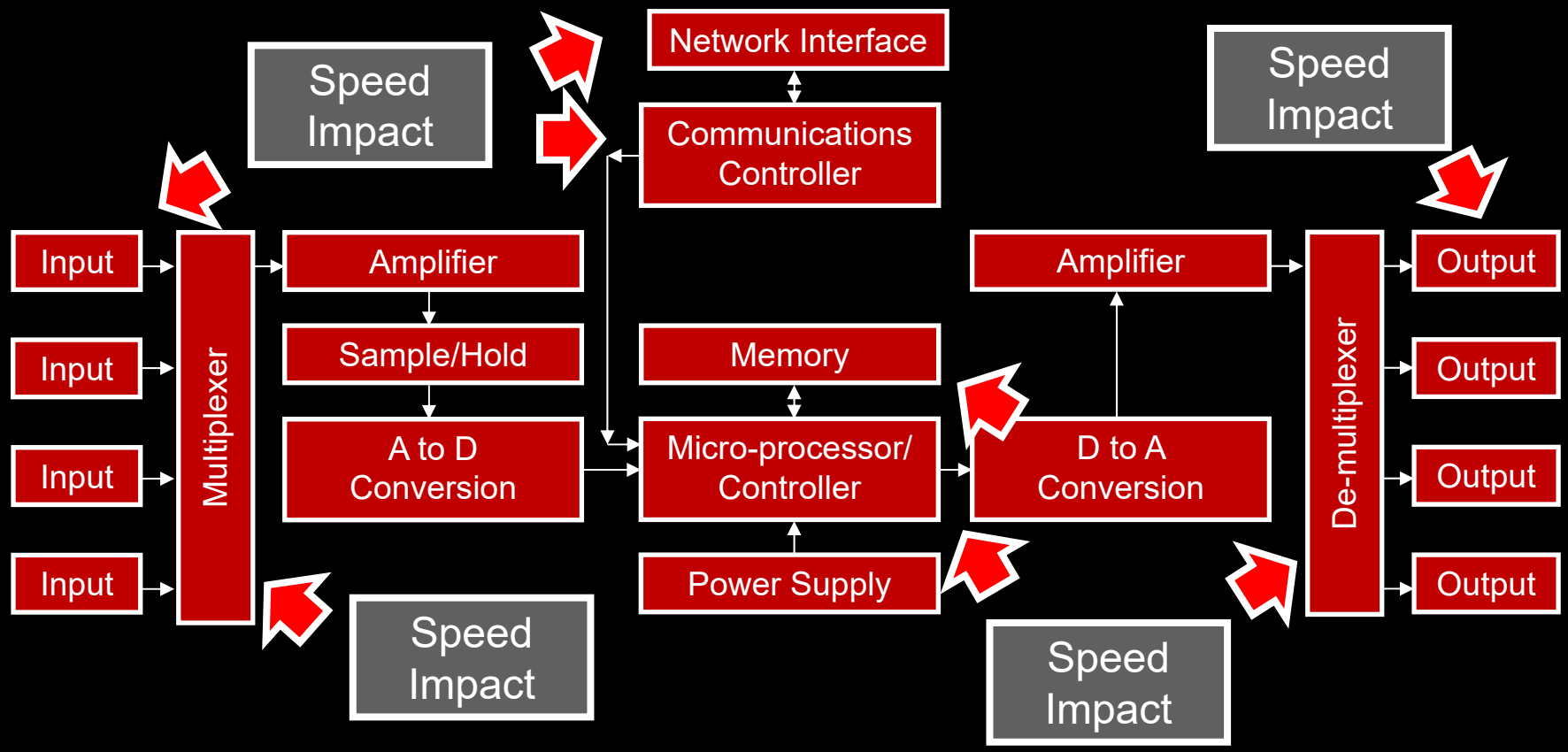
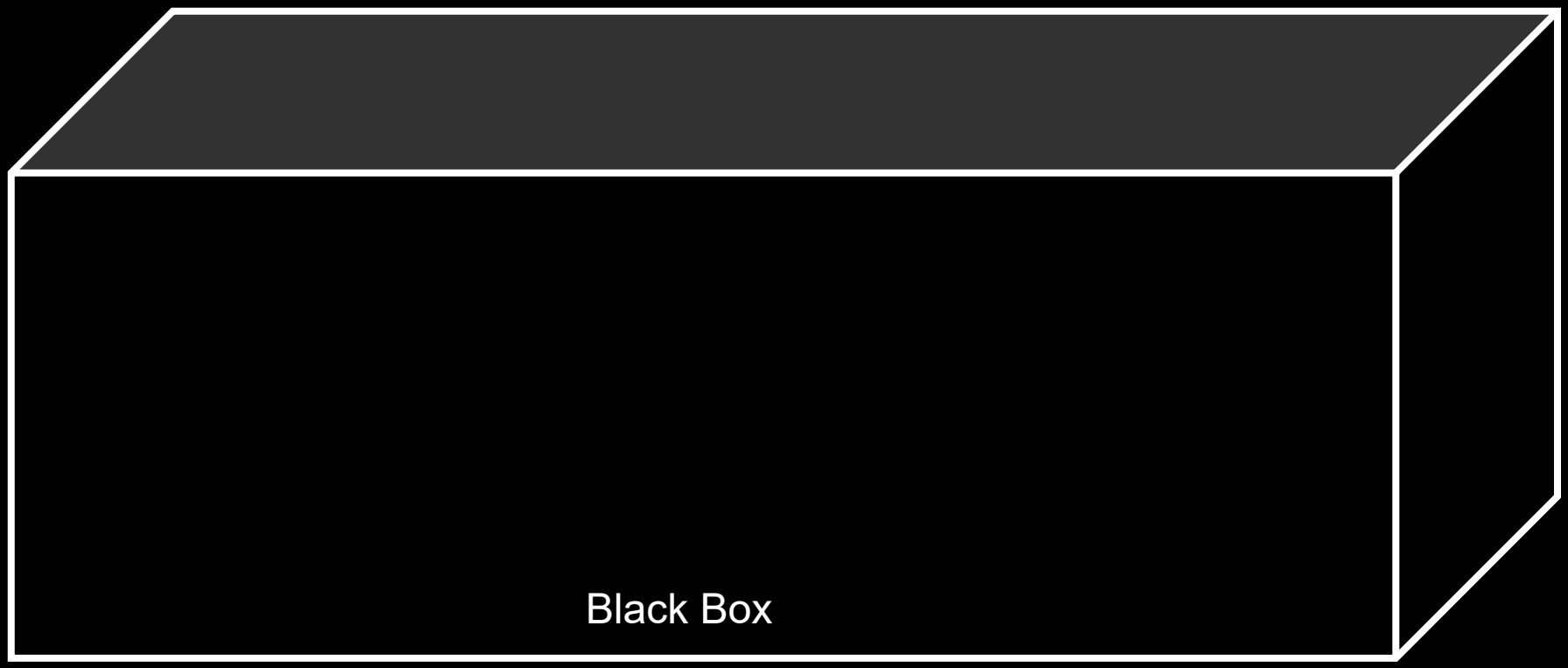


Logic Diagrams

A Way to Communicate What Goes On in the Black Box



Bottom Lines

- Repeatable, Reliable, Robust control sequences and logic are essential to successfully capturing the design intent
- To be successful:
  - Capture all of the details associated with the design intent
  - Support the logic with repeatable, reliable, robust hardware
  - Support the logic with a physical configuration that will allow it to work as intended

Logic diagrams are a tool in the Cx, EBCx and Old Timers tool box that can help ensure that the control sequence meets the design intent